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THREE NEW WESTERN DOLICHOPODIDAE*

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Three species of flies are here described as new. The material was collected in Utah, Idaho, and Colorado, with one specimen from South Dakota.

Argyra condomina n. sp.

Male. Length, 3.8 mm.; length of wing, 3.5 mm. Face silvery pollinose, short, leaving the lower corners of eyes sharply exposed, considerably narrowed on lower portion. Front and occiput heavily dusted with gray pollen. Palpi yellow, the apical portion with a few black hairs on anterior surfaces. Antennae black; first joint moderately long, bearing a few black hairs on the upper side, the lower apical corner narrowly yellowish; third joint scarcely longer than wide, densely pubescent, broadly rounded at tip, appearing somewhat silvery pollinose when viewed from in front. Lower and lateral orbital cilia white, about seven of the upper cilia on each side are black.

Dorsum of thorax dull greenish, heavily dusted with gray pollen, a narrow median vitta and the spots at base of dorsal bristles with bronze reflection. Scutellum dull green with coppery reflections, with two pairs of strong marginal bristles. Pleurae dull, somewhat greenish, the ground color barely perceptible under the heavy gray pollen; the posterior portion, above base of posterior coxae yellow, abdomen long, cylindrical, gradually tapering, black with coppery reflections; the second to fourth segments broadly yellow on lateral and dorsal portions, so that the second and third segments are narrowly black along the median line, the incisures narrowly silvery pollinose; hairs and bristles black. Hypopygium conspicuous, rounded at tip, which bears several prominent, stiff bristles; outer appendages consist of a pair of rather small, yellowish, leaf-like lamellae, which are clothed on outer surface and along the margin with delicate pale hairs; the inner organs consist of two pairs of black, triangular appendages, one pair much sharper at point than the other, both pairs apparently fused near their bases.

Coxae yellow, the middle pair broadly infuscated on outer surface. Fore coxae lightly clothed with pale hairs on the anterior surface, these hairs appear more brownish in certain lights; the usual strong bristles are present on the apical, anterior portion. Middle coxae with prominent black hair-like bristles on anterior surface; the outer surface has two strong black bristles. Hind coxae with a prominent black bristle on outer surface and a few delicate, pale hairs. Femora and tibiae yellow, the posterior femora conspicuously infuscated on upper, apical portion. Mid and hind femora each with a single preapical bristle. All femora have conspicuous black, bristle-like hairs along the lower edge; in addition there are prominent bristle-like hairs on the inner surfaces of the posterior femora. Tarsi progressively darker from the tip of first joint, so that the last three joints of all tarsi are almost wholly black. Pulvilli white, enlarged and very conspicuous, being three-fourths the length of the last tarsal joint; claws large, fringed with minute hairs. Joints of fore tarsi as 28-11-8-6-6; of mid tarsi as 30-15-10-6-6; of hind tarsi as 16-16-11-6-6. Halteres and calypters yellow, the latter with pale cilia and narrow black margin.

Wings gray, hyaline; veins brownish; fourth vein bent before the middle of last section, from which point it parallels the third vein, ending in the wing

*Contribution from the Entomology Department, Utah Agricultural Experiment Station, Logan.

tip; cross-vein approximately one-half the length of last section of fifth vein; anal angle evenly rounded, not prominent.

Female. Like the male in general coloration, differing as follows: The face, nearly three times the width of face in male, has a prominent transverse ridge on lower one-third, the extreme tip protruding, sharp, its pollen yellowish-gray; palpi nearly three times as large as in male, the anterior surfaces with conspicuous black hairs; femora lack the prominent hair-like bristles on lower edges.

Described from twenty-three males and eight females from the following localities: Twelve males and three females from Miner's Basin, La Sal Mountains, Utah, July 28, 1938; seven males and four females from Wolf Creek Pass, Utah, August 15, 1937; three males and one female from Salida, Colorado, August 3, 1938, and one male from Custer, S. Dak., July 15, 1924. The Utah specimens were taken by G. F. Knowlton and F. C. Harmston; those from Colorado by M. T. James and U. Lanham and the South Dakota specimen by H. C. Severin. *Holotype* and *allotype*, from among the Wolf Creek specimens, to be deposited in the U. S. National Museum; paratypes to be deposited in the insect collections of the Colorado Agricultural College, University of Kansas, South Dakota State College and the Utah State Agricultural College.

Differentia. It is with considerable misgivings that *condomina* n. sp. is assigned to the genus *Argyra*; the enlarged pulvilli on all tarsi, the minutely fringed claws and the extremely short third antennal joint would seem to preclude its assignment here. The general body conformation is much like certain *Diaphorus*, particularly the species *spectabilis*, or perhaps it resembles more closely the larger species of *Sympycnus*. However, the presence of hair on upper surface of first antennal joint separates *condomina* from the species of *Diaphorus* or *Sympycnus*. In chaetotaxy, structure of hypopygium and the coloration of abdomen it conforms well with the species of *Argyra*.

Argyra idahona n. sp.

Male. Length, 4 mm. Face silvery pollinose, approximately the width of fore tibia, short, leaving the lower portions of eyes sharply exposed. Front green, metallic, destitute of pollen. Palpi pale yellow, their anterior surfaces with delicate pale cilia. Proboscis black, with delicate black cilia on margin. Lower orbital cilia and whiskers white, about eight of the upper cilia on each side are black, bristle-like. Antennae black, the first joint bare above, the apical portion somewhat yellowish on lower surface; third joint triangular, slightly longer than the width at base, the tip obtusely pointed; arista sub-apical, inserted just above the tip of third joint.

Dorsum of thorax bright green, shining; the scutellum and two vittae, from which arise the acrostichal bristles, with bronze reflections; scutellum with a pair of long, stout marginal bristles outside of which is a pair of small, hair-like bristles. Pleurae green, dulled by heavy whitish pollen. Abdomen green, shining, the hairs and bristles black, except for a few pale hairs on the dorsal and lateral portions of first and second segments. Hypopygium black, shining, the left side clothed with short, stiff bristles, the right side glabrous; outer lamellae black, leaf-like, broad at base, the outer margins rounded, the inner margins straight, the apex pointed, clothed with delicate black hairs; inner appendages black, penicillate, modified to form a pair of clasping organs.

Fore coxae yellow, the anterior surface with pale hairs and a few black bristles at the tip, middle and hind coxae yellow on anterior surface, blackened on basal half of outer surfaces, the former with conspicuous black hairs on anterior surfaces, the latter with a prominent black bristle on outer surface. Femora and tibiae yellow; posterior tibiae slightly infuscated on apical fifth; fore and middle femora with conspicuous black, hair-like bristles on lower anterior surfaces; posterior femora without noticeable bristles on lower surface; the middle

tibiae have several prominent bristles on outer surface, these being nearly three times as long as the width of the tibiae. Fore tarsi becoming gradually darker from the tip of second joint, the fifth joint wholly black, the plantar surface of all joints with short, stiff bristles; middle tarsi infuscated from the tip of third joint, fifth joint of fore and middle tarsi noticeably widened when viewed from above; hind tarsi wholly black. Joints of fore tarsi as 20-8-6-5-5; of middle tarsi as 25-10-8-6-5; of posterior tarsi as 16-16-10-8-6. Halteres, calypters and the cilia of latter pale yellow.

Wings grayish hyaline; fourth vein conspicuously bent near the middle of last portion, approximately parallel with third vein immediately before entering the wing margin; last section of fifth vein about one and one-half times the length of cross-vein; anal angle prominent, evenly rounded.

Described from two males, the *holotype* taken at Sandpoint, Idaho, September 28, 1941, by F. C. Harmston; *paratype* taken at Heber, Utah, May 29, 1940, by G. F. Knowlton and F. C. Harmston. The Idaho specimen, being in better condition, is made the holotype and will be deposited in the U. S. National Museum; paratype in the collection of the senior author.

Differentia. *Argyra idahona*, in possessing glabrous first antennal joint, would fall in the *leucostola* group. In the VanDuzee key (U. S. Nat. Mus. Proc., 66:6, 1925) it keys out to *flavicoxa*, from which it differs in coloration of abdomen and hypopygial lamellae. The abdomen of *flavicoxa* has second, third and fourth segments almost wholly yellow, as are also the outer hypopygial lamellae; this species was described from a male taken in Florida.

***Peloropeodes apicales* n. sp.**

Male. Length, 1.5 mm.; of wing, 2 mm. Face on upper portion slightly wider than the width of the base of the third antennal joint, somewhat narrowed on lower portion; densely grayish pollinose, so that the black ground color is barely perceptible. Front concolorous with face. Antennae black; third joint elongated, equalling the length of posterior basitarsus, tapering to a sharp point, densely pubescent. Arista sub-apical, inserted slightly above the tip of third joint, slightly longer than the third joint. Orbital cilia white. Palpi brownish, densely pubescent.

Dorsum of thorax sub-shining because of grayish pollen, greenish-bronze. Pleurae dull green, the gray pollen nearly obscuring the ground color; posterior portions of pleurae more yellowish. Abdomen black, short, tapering rapidly from beyond the third segment. Hypopygium black, metallic; external appendages dark yellow, shining, of complicated structure; inner appendages yellow, triangular, each with two yellow bristle-like hairs at the tip.

All coxae, femora, tibiae and tarsi yellow, the latter infuscated from the tip of second joint. Fore and mid coxae with black hairs on anterior surfaces, the latter with the hairs on lower portion forming a loose clump; posterior coxae with a single black bristle on outer surface. Mid and hind femora each with a single preapical bristle. Joints of fore tarsi as 15-12-7-5-5; of mid tarsi as 22-14-12-7-6; of hind tarsi as 12-20-12-8-6. At the base of posterior basitarsus, on inner side, is a small concave area; this, however, is less conspicuous than in most members of the genus. Halteres and calypters yellow, the latter with the tip and cilia black.

Wings grayish hyaline; third and fourth veins slightly convergent toward their tips; the apical portion of fifth vein is gently curved forward so that it forms an acute angle where it enters the wing margin; comparative lengths of the cross-vein and the last section of fifth vein as 8 to 30.

Described from one male, taken at Coeur d'Alene, Idaho, September 28, 1941, by F. C. Harmston. Type to be deposited in the U. S. National Museum.

Differentia. This species is distinguished from other known *Peloropeodes* by the structure of the antennae. The sub-apical insertion of arista occurs in no other known species.

NEW NEARCTIC CRANE-FLIES (TIPULIDAE, DIPTERA),
PART XXIV.

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The preceding part under this title was published in 1945 (Can. Ent. 77: 1-6). In the present article I am describing various novelties from the western United States and Canada, received from different entomologists who are listed under the individual species and to whom my sincere thanks are extended. Except where indicated to the contrary, the types of the various novelties are preserved in my personal collection of these flies.

***Tipula (Yamatotipula) nuntia* n. sp.**

Allied to *fulvilineata*; general coloration grey, the praescutum with four greyish brown stripes that are broadly margined with slightly darker brown, with a still darker median vitta; antennae relatively long, the basal flagellar segments bicolored, brownish black, their bases obscure yellow; wings pale brown, variegated with darker brown and whitish subhyaline, the latter including a large discal area in Cell *M* and before cord; cells beyond cord darkened, a little paler in the medial field; abdominal tergites grey pruinose, with two broad dark brown sub-lateral stripes; the lateral tergal borders broadly yellow; male hypopygium with the caudal margin of tergite with two obtusely rounded lobes; inner dististyle with the rostral portion flattened, the apex truncated; posterior portion of style with three darkened lobes, the most posterior split at apex into two obtuse lobes.

Male. Length about 14 mm.; wing 14 mm.; antenna about 5 mm.

Frontal prolongation of head short, only about one-half as long as remainder of head, grey above, more brownish yellow on sides; nasus long and conspicuous; palpi dark brown. Antennae relatively long; scape and pedicel dark brown, grey pruinose, proximal four or five flagellar segments bicolored, the basal enlargements obscure yellow, the remainder brownish black, the outer segments uniformly blackened; first flagellar segment cylindrical, with about the proximal half yellow; succeeding segments with the basal swellings feebly developed; verticils sparse and very short. Head light grey with a dark median area.

Pronotal scutum grey; scutellum obscure yellow. Mesonotal praescutum with the ground clear grey, with four greyish brown stripes that are broadly margined with slightly darker brown, the intermediate pair separated by a much darker capillary median vitta; scutum grey, the lobes extensively darkened; posterior sclerites of notum light grey, with a narrow brown median vitta; pleurotergite grey, variegated with yellow, especially on posterior border of the katapleurotergite. Pleura clear light grey, the metapleura paling to yellow; dorsopleural membrane buffy yellow. Halteres dark brown, the base of stem restrictedly yellow. Legs with the coxae light grey; trochanters yellow; femora and tibiae light brown, the tips narrowly blackened; tarsi passing into black; claws toothed. Wings relatively narrow, the ground color pale brown, variegated with darker brown and whitish subhyaline, prearcular and costal fields more uniformly brownish yellow; the darker pattern includes a seam behind the costal border, involving all of cell *R* except the distal end, stigma, anterior cord, and a comparable brown seam along *Cu* and *m-cu*; cells beyond cord uniformly paler brown, the median field a trifle paler than the radial; the pale areas include a major discal mark involving all the cell *M* except the distal margin and a broad obliterative patch before cord and stigma, becoming more yellowed at the costal border; no brightening in the cells beyond cord, excepting the posterior cells and 1st *M*₂, which are a trifle paler; veins brown. Venation: *Rs* a little less than three times *m-cu*; cell 2nd *A* relatively narrow.

Abdomen with the tergites medially broadly grey pruinose, the caudal borders narrowly pale; a broad dark brown sublateral stripe, the lateral tergal borders broadly yellow; impressed areas on basal rings of tergites conspicuous; sternites concealed by the overlapping tergal borders; hypopygium brownish yellow. Male hypopygium having the posterior border of the ninth tergite produced into two obtuse lobes that are separated from one another by a small U-shaped notch; lobes provided with relatively sparse, short, strong, spinous setae. Outer dististyle broadly flattened, the greatest width exceeding two-thirds the length, the apex obtusely rounded. Inner dististyle with the rostral portion flattened, the apex truncated, the apical angles, especially the lower one, obtusely rounded; outer margin of rostrum with numerous erect, long, yellow setae that are strongly curved at their tips; posterior portion of style complex, including three more or less distinct darkened lobes, the most posterior, presumably representing the outer basal lobe, split into two obtuse lobules, the paler one tipped with several strong setae. Gonapophysis at apex expanded into a broadly flattened head.

Habitat: Washington (Whitman County).

Holotype: ♂, Pullman, July 4, 1922 (A. L. Melander); Alexander Collection through courtesy of Doctor Melander.

The present fly is nearest *Tipula* (*Yamatotipula*) *fulvilineata* Doane, from which it is readily distinguished by the bicolored basal flagellar segments, the different wing pattern, and the distinct details of the hypopygium, especially the tergite and inner dististyle.

***Tipula* (*Oreomyza*) *banffiana* n. sp.**

Size above medium (wing, male, about 16 mm.); general coloration grey, the praescutum with four entire dark brown stripes; antennae with basal two segments yellow, flagellum black; halteres with stem yellow, knob dark brown; femora and tibiae yellow, the tips narrowly infuscated; wings whitish subhyaline, clouded with dark brown and brownish grey, the ground including extensive areas before and beyond the cord and near the wing base; abdomen yellow, the tergites with three inconspicuous brown stripes, the outer segments, including hypopygium, dark brown; ovipositor with cerci long and slender; male hypopygium with the caudal border of the ninth tergite broadly notched; inner dististyle a broad flattened subquadrate yellow blade, the outer apical angle produced into a blackened spine; eighth sternite narrowed outwardly, at apex bearing two small fleshy lobes.

Male. Length about 13-14 mm.; wing 15.5-16 mm.; antenna about 3.2 mm.

Female. Length about 21 mm.; wing 18 mm.

Frontal prolongation of head moderately long, distinctly shorter than remainder of head; brown, heavily grey pruinose on dorsal surface; nasus distinct; palpi black. Antennae with scape and pedicel clear light yellow, flagellum black; flagellar segments only moderately incised; verticils shorter than the segments. Head grey, light grey in front and on the tumid vertical tubercle; posterior vertex with darkening on sides and as a median vitta.

Pronotum brownish grey. Mesonotal praescutum grey, with four entire dark brown stripes, the median ground vitta clearer grey; interspaces somewhat more obscured grey with tiny black setigerous punctures; posterior sclerites of notum grey, each scutal lobe vaguely patterned with brown; scutellum somewhat more brownish grey; a more or less distinct central dark line on mediotergite; pleurotergite darker grey on the aneploertergite than on the clear light grey katapleurotergite. Pleura light grey, vaguely patterned with darker on the anepisternum and ventral sternopleurite. Female with a more evident dorsal dark line on anepisternum; dorsopleural membrane buffy yellow, weakly infuscated behind in both sexes. Halteres with stem yellow, knob dark brown. Legs with coxae light grey; trochanters yellow; femora and tibiae obscure yellow, the tips narrowly and gradually infuscated; basitarsi obscure yellow, passing into brownish black; claws (male) toothed.

Wings with the ground color whitish sabhyaline, most extensive on proximal third of wing; stigma dark brown; somewhat paler brown clouds at origin of R_s and over anterior cord; still paler brownish grey clouds over most of wing, especially the outer half or more, more intense as a broken band at near one-third the length of wing, in outer portion of cell M , and in the apical cells; the whitish ground includes a band beyond stigma, wider and more distinct in female, extending into base of cell M_2 , in male more interrupted in base of cell R_5 ; the white band before cord similarly developed, in female meeting the post-stigmal area in cell 1st M_2 ; further whitish areas include a vague brightening in outer end of cell R_5 , end of vein 1st A , outer end of cell 1st A near vein 2nd A , and elsewhere near the wing base; veins dark brown, more yellowish brown in the paler fields. Venation: *m-cu* long, from one-half to about two-fifths R_5 ; $R_1 + 2$ pale but entire.

Abdominal tergites chiefly yellow; the first segment more pruinose; a narrow median brown stripe in female, much less indicated in male; tergites with sub-lateral dark stripe slightly indicated, the lateral tergal borders paling to grey; basal sternites yellow; outer segments, including hypopygium, chiefly dark brown. Female with cerci long and slender, straight, entirely smooth. Male hypopygium with the ninth tergite having the caudal margin broadly emarginate, at base of notch with a small square incision that leads cephalad into a dorsal groove; at center of this smaller notch with a tiny compressed point or microscopic blade; adjoining angles of the notch produced into small acute spinous points; lateral tergal lobes obtusely rounded. Ninth sternite with the appendage small but elongate, inconspicuous. Basistyle entire, the posterior border convexly rounded, not produced. Outer dististyle elongate, flattened, widest at and beyond midlength, the tip obtusely rounded. Inner dististyle a broadly flattened subquadrate yellow blade, at apex narrowed into the beak, the lower beak close to the tip of the latter; outer posterior angle of style produced into a short, erect, blackened spine, the corresponding basal angle produced into a somewhat smaller similar point; entire posterior portion of style with abundant microscopic setulae and a fringe of longer yellow setae. Phallosome terminating in a blackened spinous point that is subtended by two shorter, much more slender, yellowish spines. Eighth sternite moderately sheathing, narrowed outwardly, the apex produced into two small fleshy lobes that are provided with long yellow setae.

Habitat: Alberta.

Holotype: ♂, Banff, July 15, 1922 (C. B. D. Garrett). *Allotopotype*: ♀. *Paratopotypes*: 2 ♂♂; holotype and allotype in Canadian National Collection, paratypes in Alexander Collection.

From the relatively few described species of the subgenus so far discovered in the western Nearctic Region, the present fly is well distinguished by the very distinct male hypopygium, particularly the inner dististyle.

***Tipula (Lunatipula) tenaya* n. sp.**

Allied to *spendens*; general coloration of thorax yellow, the praescutal stripes poorly differentiated; legs yellow, only the outer tarsal segments darkened; wings brownish grey, the prearcular and costal fields clear yellow; stigma small, pale brown; abdomen yellow, tergites three to six with conspicuous, sublateral, dark brown spots; male hypopygium with the tergite very broad, its caudal border widely emarginate, the small lateral lobes weakly armed; basistyle produced into a stout lobe that is weakly bifid at apex; outer dististyle very small; eighth sternite narrowed outwardly, the apex emarginate, fringed on either side of midline with long yellow setae.

Male. Length about 13-13.5 mm.; wing 14-14.5 mm.; antenna about 4-4.2 mm.

Female. Length about 16 mm.; wing 15 mm.

Frontal prolongation of head relatively long, a little shorter than the remainder of head, yellow, sparsely pruinose dorsally at base; nasus long and slender;

palpi with basal three segments brownish yellow, the remainder dark brown. Antennae with scape and pedicel yellow; first flagellar segment obscure yellow, more infuscated apically beneath, remainder of antenna black; flagellar segments only moderately incised; longest verticils a little shorter than the segments. Head grey, darker medially, clear light grey on front and orbits; a more or less distinct darker median vitta on vertex.

Pronotum brownish yellow. Mesonotum chiefly obscure yellow to brownish yellow, the praescutal stripes scarcely or poorly differentiated from the ground. Pleura yellow, very sparsely pruinose; dorsopleural membrane yellow. Halteres with stem obscure yellow, the base narrowly clear yellow, knob dark brown. Legs with the coxae and trochanters yellow; remainder of legs yellow, the outer tarsal segments dark brown; claws toothed. Wings brownish grey, the prearcular and costal fields clear yellow; stigma small, pale brown; obliterative band at and before cord narrow and relatively inconspicuous, extending into base of cell M_3 ; most of veins narrowly and insensibly bordered by whitish subhyaline; veins dark brown, those in the luteus fields clear yellow, the tip of vein Sc abruptly darkened. Venation: R_s about two and one-half to nearly three times $m-cu$; $R_1 + 2$ entire.

Abdomen obscure yellow, the tergites without median darkening; tergites two to six, inclusive, with a conspicuous dark brown spot, on tergite two at near midlength, on the others near the base of segment; hypopygium more castaneous. Ovipositor with cerci relatively deep and compressed, the tips obtuse. Male hypopygium with the ninth tergite very broad, its caudal margin with a correspondingly widened median notch, the margin of which is microscopically toothed; these denticles larger and more conspicuous on the sides of the emargination; caudal border at base of notch with conspicuous black setae; lateral lobes correspondingly reduced, each terminating in a small, irregular flange or point. Ninth sternite with the appendage relatively small, its lower portion very obtuse to subtruncate, provided with long, conspicuous yellow setae. Basistyle entire, produced into a strong lobe or arm that is separated from most of style by pale membrane, the arm terminating in a weakly bifid point including one more spinous flange; surface of arm with several strong setae. Outer dististyle reduced to a tiny lobe. Inner dististyle relatively large and conspicuous; beak blackened, slightly uptilted at apex; lower beak similarly darkened; separated from the beak by a narrow notch; dorsal crest separated from the beak by a strong constriction; outer basal lobe relatively small, not as large as the dorsal crest, its outer portion with unusually long dense setae; sensory area comprised of about 18 facets. Gonapophysis appearing as simple, relatively small, straight spines. Eighth sternite sheathing, more narrowed outwardly; apex emarginate, on either side with a low lobe or cushion that bears long conspicuous yellow setae.

Habitat: California (Mariposa County).

Holotype: ♂, Mirror Lake, Yosemite National Park, altitude 4000 feet, June 6, 1939 (A. Downes). *Allotopotype*: ♀, pinned with type. *Paratopotypes*: 4 ♂ ♂.

The specific name, *tenaya*, is that of the chief of the Yosemite Miwok Indians at the time of the discovery of the valley by the Whites, in March, 1851. The fly is most nearly related to *Tipula* (*Lunatipula*) *miwok* Alexander and T. (*L.*) *splendens* Doane, particularly to the latter. It differs conspicuously in all details of structure of the male hypopygium, particularly of the tergite, basistyle and inner dististyle.

***Tipula* (*Lunatipula*) *bernardinensis* n. sp.**

Allied to *splendens*; size small (wing, male, 11 mm.); general coloration of thorax and abdomen yellow, abdominal tergites two to five with conspicuous, oval, dark brown, lateral spots; wings with a weak brownish tinge, the prearcular and costal fields more yellowed, stigma medium brown; male hypopygium with the

caudal margin of tergite broadly emarginate; lateral lobes relatively narrow; each with a tridentate sclerotized flange near apex; other smaller denticles nearer mid-line of tergite; basistyle produced into a slender, acutely pointed spine; inner dististyle simple, arcuate, the beak relatively stout and sloping gradually back to the dorsal crest, the outer basal lobe not developed; eighth sternite with the setiferous area relatively small, the setae yellow, those elsewhere on sclerite black.

Male. Length about 12 mm.; wing 11 mm.; antenna about 3.1 mm.

Frontal prolongation of head relatively long, subequal to the remainder, shiny yellow, dusted above at base with light grey; nasus long and slender; palpi with basal three segments obscure yellow, the terminal segment blackened. Antennae with basal three segments light yellow, the apex of first flagellar segment weakly darkened; remainder of organ brownish black, the basal enlargement a very little more intense; flagellar segments weakly incised; longest verticils shorter than the segments. Head above light grey, with a capillary darker median vitta.

Prothorax and mesothorax almost uniformly reddish yellow, very sparsely pruinose, without clearly defined markings, excepting the broad central area of praescutum and centers of the scutal lobes that are clearer reddish, without pruinosity; dorsopleural membrane light yellow. Halteres with stem light brown, its base narrowly light yellow, knob infuscated. Legs with coxae yellow, very sparsely whitened; trochanters yellow; femora, tibiae and basitarsi obscure yellow, the tips scarcely darker; outer tarsal segments brownish black; claws (male) toothed. Wings with a weak brownish tinge, the prearcular and costal fields more yellowed; stigma medium brown; veins dark brown. Venation: *Rs* about three times as long as *m-cu*, cell *M*₄ not widened at the latter vein.

Abdomen chiefly yellow, tergites two to five, inclusive, with conspicuous oval dark brown spots on the sublateral portions, placed near base of segments except the first which is near midlength; lateral and caudal borders of tergites narrowly pale; sternites and hypopygium yellow. Male hypopygium with the caudal margin of the ninth tergite broadly emarginate, the lateral lobes relatively narrow, each at apex extended into a narrow point; on margin of lower face with a tridentate sclerotized flange; central portion of emargination with other denticles, with a more sclerotized ventral point that is directed mesad; median line of dorsal surface pale and more membranous. Ninth sternite with the appendage relatively large, its upper portion pale, the slightly more narrowed lower end somewhat more sclerotized, with the setae long and strongly reflexed. Basistyle entire, produced into a long slender spine, its tip acute, the setae restricted to the proximal half or slightly more; a membranous area near base of spine. Outer dististyle small, spatulate. Inner dististyle simple, arcuate, narrowed to the beak, the latter relatively stout and sloping gradually back to the dorsal crest; lateral face of beak with a narrow blackened carina that extends back about to opposite the small conical lower beak; surface of style with a long narrow sclerotized flange; main body of style with all setae directed strongly backward; outer basal lobe not developed. Eighth sternite sheathing; caudal margin truncate or slightly convex, with a relatively small central setiferous area, the long setae yellow, those toward the midline somewhat shorter; setae of remainder of sclerite black, some on the outer apical margin longer and more conspicuous.

Habitat: California (Riverside County).

Holotype: ♀, Idyllwild, altitude 5400 feet, June 15, 1940 (C. D. Michener).

The present fly is allied to various other small species that center around *Tipula* (*Lunatipula*) *splendens* Doane, including besides the latter *T. (L.) mtiwok* Alexander, *T. (L.) pleuracacula* Alexander (*arizonica* Alexander) and *T. (L.) tenaya* n. sp. The most similar of these allied forms is *pleuracacula* which differs most evidently in details of structure of the male hypopygium, including the tergite, inner dististyle and eighth sternite.

CONCERNING CERTAIN NORTH AMERICAN COLEOPHORIDS WITH UNICOLOROUS BROWN WINGS (LEPIDOPTERA) *

BY J. McDUNNOUGH,
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A number of our species of North American Coleophoridae are characterized by their unicolorous dark gray-brown forewings and lack of a prominent basal tuft on the antennae, making an identification of the individual species a rather difficult matter unless recourse be had to genitalic characters which in both sexes offer excellent means of separation. In a recent check-up of material in the Canadian National Collection belonging to this group it soon became evident that not only were more species represented than were covered by available names but also that certain changes were apparently necessary in the application of such names as did exist. In the present paper an effort is made to straighten out the nomenclature and to illustrate characters, particularly those found in the female genitalia, whereby the individual species can be definitely separated from one another.

Heinrich in Forbes, Lepidoptera of New York & Neighboring States (1924, Mem. 68, Corn. Univ. Agri. Sta., 206) has given us the first workable key to these species which he places in his Group 1 (pp. 208-10) and characterizes as 'Moths with fore wings gray-brown, unicolorous, sometimes tinged with ochreous or darker shades but not striped or otherwise marked.' Nine species are included, occupying in his 'Key to the Species' (p. 206) the captions 4-9. Of these nine species I have recently shown (1945, Can. Ent. (1944) LXXVI, 239) that *cinerella* Cham. has been misidentified and belongs in the so-called 'pistol case group' in which the adults are furnished with a large basal tuft of hairs on the antennae. The type of *zelleriella* Cham. is apparently lost (McDunnough, *op. cit.* 237); the original description calls for a species of about 10 mm. wing expanse, 'slate color, tinged with ochreous; apex of the abdomen yellowish.' The case is described as 'ochreous, slender, cylindrical, tapering a little to each end, and compressed or pinched at the posterior end, so as to divide it into three small ridges. It is about half an inch long and was found adhering to the bark of sugar trees (*Acer saccharinum*). The description of the adult is not sufficient for accurate determination; the case as described must have similarity to that of the well-known cigar case-bearer on apple but is considerably longer and paler in color; it is problematic whether the maple-bark on which it was found had any relation to the food-plant of the larva. The species was unknown to Heinrich, who was inclined — I believe erroneously — to associate it with *cerasivorella* Pack. Until collectors in the Kentucky region can again discover cases that agree with Chambers' description and breed adults the species must remain unplaced.

With regard to *cerasivorella* Pack. I incline very much to the belief that the species has been misidentified by Heinrich. He separates it — along with *zelleriella* — in the first line of couplet 4 of his key as follows 'Apex of fore wing distinctly tinged with grayish ochreous' as contrasted with other species where the apex of fore wing is 'not distinctly tinged with grayish ochreous', basing his determination on specimens in the U. S. N. M. from Bellingham, Wis.,† bred from apple. However, Packard in his original description gives the color as 'uniform dark stone gray' and later says 'The wings have no markings, being dark gray with darker scales'; he also designates the head as 'whitish gray.' This description was based on material bred from cases on cherry collected at Salem, Mass.; unfortunately no types of the species could be located in the Museum of Comparative Zoology, Cambridge, Mass., on a recent visit, and they probably no longer exist. Packard's description fits in best with the species long known as *fletcherella* Fern. but listed in my 1938 Check List as *occidentis* Zell. with *fletcherella* as a synonym; thus synonymy, I believe to be correct as the only difference between the larval cases—

* Contribution No. 2367, Division of Entomology, Science Service, Department of Agriculture, Ottawa.

†Can this be an error for 'Washington'.

as noted by Heinrich — is the presence of a serrate dorsal edge on certain of the *occidentis* cases, due, as Zeller himself states, to the edge of the leaf forming part of the case, and not to be considered as of any specific value; Zeller's statement is as follows, with the important features italicized by me—'Längskiel des Rückens *entweder auch einfach oder aus einem gekerbten (offenbar aus einem Blattrand gebildeten)* flügelartigen, höheren Hautrand bestehend.' A male specimen before me, bred from a case with serrate edge on *Prunus* shows identical genitalia with specimens bred from smooth cases from apple or pear as figured by me (1933, Can. Ent., LXV, 160, Pl. X, fig. 1). It might be further noted that Zeller's material on which the name *occidentis* was based was furnished by Burgess, then curator of the Cambridge Museum; it was therefore practically topotypical with Packard's material of *cerasivorella* and might even have been part of the same lot.

Packard's description having priority over those of Zeller and Fernald, the name *cerasivorella* Pack. must replace *occidentis* Zell. and *fletcherella* Fern. for the well-known cigar-case-bearer of apple and allied plants, an unfortunate but apparently unavoidable change. The male genitalia are readily recognized by the thin, curved, cylindrical, *unarmed* aedeagus, the rather bluntly truncated apex of sacculus, which shows fine spiculation along the dorsal edge, and the short, stubby clasper. The very characteristic female genitalia are figured on the accompanying plate (fig. 1). The species must be very closely allied to the European *nigricella* Haw.

Laricella Hbn., the well-known larch-case-bearer, needs no further comment. The genitalia have been fairly satisfactorily illustrated by Pierce (1935, Gen. Brit. Tin., Pl. XLI). Attention might be called to the unique type of gnathos in the male genitalia which lacks the usual terminal pad of comb teeth.

Unicolorella Cham., the *Juncus*-feeder, has already been discussed by both Dr. A. Braun and myself. The genitalia are figured in one of my recent papers (1942, Can. Ent., LXXIV, 171, Pl. XIII, figs. 3, 4).

Concolorella Clem. is entirely unknown to me. Heinrich refers to it as 'a pale mauve species near *cinerella* Cham.' but this does not agree with the original description which states that the entire insect is of a uniform, rather *dark yellow-ochreous* colour' (the italics are mine). It was based on a single specimen captured on June 13. There is a possibility that this name may supercede *nigralineella* Cham. as the coloration of the two would appear to be very similar, judging by descriptions alone.

The last of the species listed by Heinrich, *pruniella* Clem., has been very satisfactorily tied down by Dr. Braun (1914, Jour. Cin. Soc. Nat. Hist. XXI, 157). The well-known type of holster-case was figured by me in connection with a discussion of the species (1933, Can. Ent., LXV, 163, Pl. X, fig. 2). In the male genitalia a long thin terminal spine on the aedeagus is very characteristic and can be recognized without making a slide; the female genitalia which I figure (fig. 8) are equally characteristic with the two lateral pockets bordering the ostium and the accessory blind sac at the commencement of the ductus bursae. *Pruniella* appears to be one of a group of so-called species in which the coloration of the adults, the type of larval case and the genitalia show very great similarities, the distinguishing feature being the food plant of the larva; thus we have *pruniella* feeding on *Prunus* and possibly *Myrica*, *insolabilis* Brn. with cases on *Populus balsamifera*, (McDunnough, *op. cit.*, 165, Pl. X, fig. 3) the spurious *cinerella* Heinr. (*nec* Cham.) which feeds on birch (McDunnough, *op. cit.*, 163) and is now without a name, and the *Juglans*-feeder, *nigralineella* Cham. (*ochrella* Cham.), which I have just transferred to this group (1945, Can. Ent., LXXVI, 237) after a study of the types; the western *piperata* Brn. also belongs here.

In the group there seems to be a gradual color-gradation from the deep smoky-brown wings of *pruniella*, through *insolabilis* and the birch-feeder—which both show at times tinges of ochreous, especially in the females—to the deep

ochreous *nigralineella*; otherwise the moths are so similar as to make an identification almost impossible without a knowledge of the food-plants. As, in all probability, the larvae are restricted to their individual food-plants there seems no harm done in treating each type as a species for the present, until such time as intensive study and breeding experiments can be undertaken.

Since the publication of Heinrich's key a number of other species with unicolorous brown wings have been described. *Salmani* Heinr. with its deep smoky wings appears to belong to the Atlantic coast area: it was described from Mt. Desert, Me. and I have found the cases very abundant on both birch and alder at Parrsboro, N. S. in early July; the chunky case with trilobed apex is attached to the upper side of a leaf for pupation and, in consequence, is readily seen. The male genitalia with the short, triangularly shaped sacculus are quite distinct; the female genitalia are figured in the present paper (fig. 2).

Kalmiella McD. (1936, Can. Ent. LXVIII, 53) shows frequently considerable ochreous suffusion on the primaries and is quite shiny in appearance; the male genitalia and the cases have been figured in the original description and I now give a figure of the female genitalia (fig. 4).

The allied and most recently described *salicivorella* McD. (1945, Can. Ent., LXXVII, 49) was adequately illustrated in the original description.

Asterophagella McD. (1944, Can. Ent., LXXVI, 108) might, to all intents and purposes, be classed as a unicolorous brown species, although its affinities belong with a striate group of species. Its genitalia have been illustrated.

The following species appear to be unnamed.

***Coleophora insulicola* n. sp.**

Unicolorous deep smoky-gray, very similar to *salmani* in color and apparently allied to this species. Head scarcely paler than wings, palpi and hind legs rather lighter in color. Antennae very definitely annulate with white and brown alternating rings. Expanse 12 mm.

Female Genitalia (fig. 7). Quite similar to those of *salmani*. Genital plate broader than high, roughly rectangular with the caudal margin weakly concave. Ostium almost circular, more so than in *salmani*, and situated further below caudal margin than in this species. Ductus bursae evenly narrow, the initial section chitinated for a short distance, then membranous, somewhat twisted, and describing a convolution just before entering the bursa; the proximal section shows a fine median bar of chitin before the exit of the ductus seminalis. Bursa rather small, broadly oval and without signum.

Holotype — ♀. Brackley Beach, Can. Nat. Park, Prince Edward Island, July 26, 1940 (G. S. Walley); No. 5615 in the Canadian National Collection, Ottawa.

***Coleophora paludicola* n. sp.**

Palpi with third joint upcurved and with small apical tuft on second joint ventrally; light smoky gray outwardly, whitish inwardly and at base. Antennae with smoky brown basal joint, which is rather narrow and very weakly tufted; balance of antennae very definitely annulate with alternating white and brown rings. Thorax and wings deep smoky brown, the primaries somewhat shiny and with faint traces of darker sprinkling in apical section — not to be distinguished superficially from *salicivorella* McD. Legs dark gray, the hind tarsi feebly annulate at apices with whitish. Expanse 12 mm.

Female Genitalia (fig. 3). Very distinctive. Genital plate helmet-shaped, the lobes widely separated apically, projecting with a slight incurve beyond the mouth of the ostium and feebly setose. Ostium broad, situated well below caudal margin of plate, with raised triangular lateral edges. Ductus bursae narrowing quickly to a long, fine, membranous tube, broadening somewhat, twisted and feebly spiculate in the median section which gives rise to the ductus semin-

alis. Bursa long, narrowly pear-shaped, with signum reduced to a minute thorn.

Holotype—♀, Blackburn (Mer Bleue), Ont., June 13, 1939 (J. McDunnoagh); No. 5616 in the Canadian National Collection, Ottawa.

A somewhat larger male, taken in the same cold bog, called the Mer Bleue, east of Ottawa, is before me and seems to represent the other sex of the species. Unfortunately the genitalia are broken.

***Coleophora affiliatella* n. sp.**

Scarcely to be distinguished from the preceding species on superficial characters except for the deeper coloration of the head, basal antennal joint and fore wings, the latter being besides considerably shinier. The antennae are well-annulated. Expanse 12 mm.

Female Genitalia (fig. 6). Strikingly different from those of *paludicola* and showing more similarity to those of *pruniella*. The genital plate is rather broad, slightly crinkled and with rounded lateral edges; the two lobes are well separated by a median incision and their caudal margins are rather irregular and apparently non-setose. The ostium is situated at the cephalic margin of the plate and forms a half-oval with slightly raised edges and depressed centre. The narrow initial portion of the ductus bursae is short, membranous and with a median chitinous band, arising from the bottom of the ostium; it expands into a dark, strongly spiculate section through which the chitinous band continues. Following this is a finely spiculate membranous section from which the ductus seminalis arises, then the tube narrows, becomes twisted and forms a single broad convolution just before entering the bursa which is a large oval sac armed with a strong signum, consisting of a curved spine arising from a lunate base.

Holotype—♀, Mer Bleue, Ottawa, Ont., June 25, 1935 (W. J. Brown); No. 5617 in the Canadian National Collection, Ottawa.

In conclusion I append the description of a new species from the Maritimes which does not belong in the above group but for which a name is needed in order to distinguish two superficially very similar species.

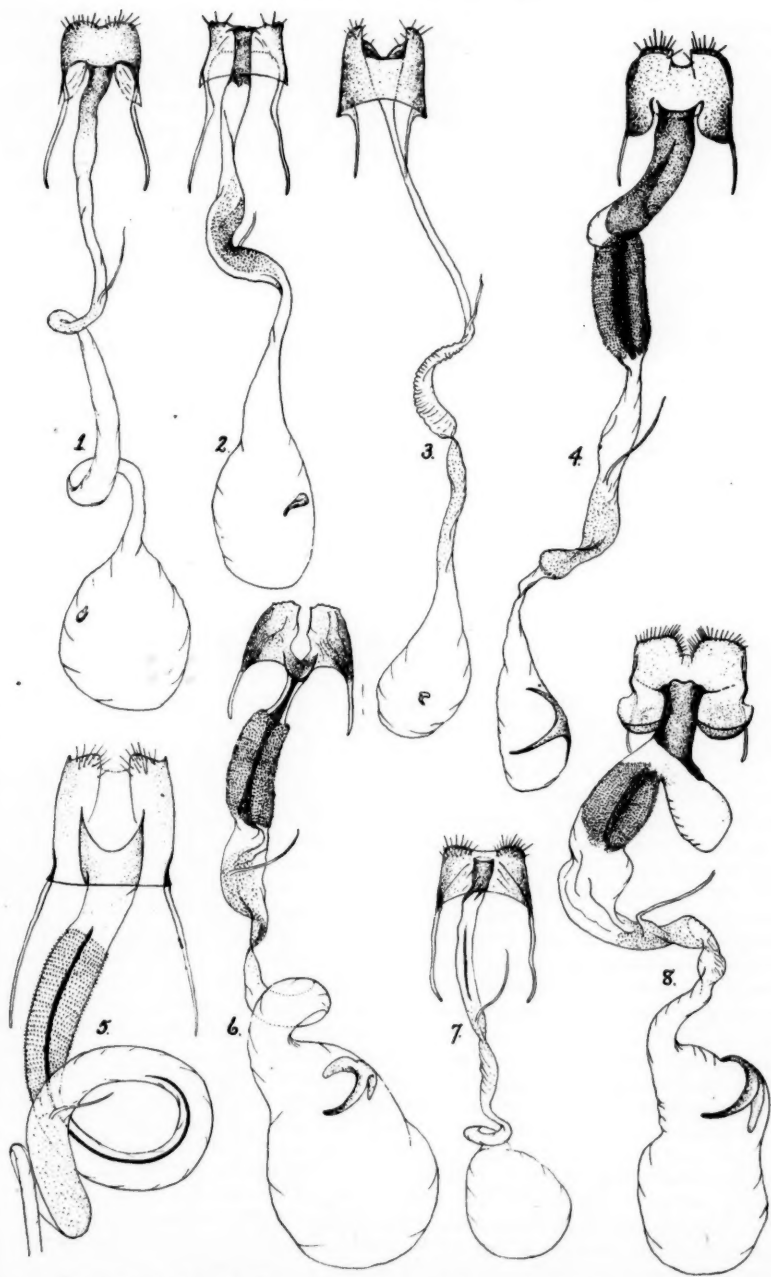
***Coleophora salinoidella* n. sp.**

Very similar in general coloration to *littorella* McD., but considerably larger.

Palpi with moderate apical tuft to second joint, pale creamy, shaded with light brown laterally on the apical two-thirds of the second joint and at the base of the third joint. Antennae very pale creamy with hardly a trace of darker annulations. Head and thorax light ochre-brown. Primaries almost unicolorous light ochre-brown, with only faintest traces of paler longitudinal striae in the costal and apical regions; a light sprinkling of smoky scaling (at times almost obsolescent), more pronounced in apical region. Costal and apical fringes concolorous, changing to light smoky along inner margin. Secondaries with fringes rather deep smoky. Fore legs ochreous outwardly, blackish inwardly; hind legs fringed, light brown outwardly, paler inwardly. Expanse 15 mm.

Male Genitalia. In general very similar to those of *littorella*. The aedeagus, however, is much longer, narrowly trough-shaped, with well-chitinized, raised sides which taper rather abruptly toward their apices, ending close together in a blunt point. No armature of spines or teeth present. The number of cornuti in the vesica is increased (as compared with the four present in *littorella*) to five or six, closely appressed in a longitudinal row, long and thin, except the terminal one which has a broadened base.

Female Genitalia (fig. 5). Much more characteristic than the male genitalia in the distinctions from *littorella*. The genital plate is slightly higher than broad; the two lobes are widely separated in the median area, the caudal edge of plate showing little projection centrally but with a small tooth in each outer corner. The semicircular ostium is situated well cephalad of the centre of



Female Genitalia of 1. *Coleophora cerasivorella* Pack. (*fletcherella* Fern.). 2. *C. salmani* Heinr. 3. *C. paludicola* n. sp. 4. *C. kalmiella* McD. 5. *C. salinoidella* n. sp. 6. *C. affiliatella* n. sp. 7. *C. insulicola* n. sp. 8. *C. pruniella* Clem.

the plate and noticeably raised above its level. The sides of the initial chitinated portion of ductus bursae are parallel as far as the cephalic margin of the plate, then narrowing to a membranous tube and bending slightly to the left for a short distance. A dark spiculate area follows, about *twice the length* of that of *littorella*, the tube then again becoming membranous and making a *large convolution*; the usual fine chitinous band runs through the centre of both the spiculate and convolute sections. A half convolution follows, the tube in this area being finely spiculate; it then narrows to half its width and descends in numerous small convolutions to the bursa, broadening somewhat before entering same. In the membranous bursa the curved thorn of the signum is larger than that of *littorella*; a well-defined, thin, spiculate, chitinous bar is also present.

Holotype—♂, Parrsboro, N. S., Aug. 10, 1943 (J. McDunnough); No. 5552 in the Canadian National Collection, Ottawa.

Allotype—♀, same date, Aug. 13.

Paratypes—6 ♂, 1 ♀, same data as holo- and allotypes; 1 ♂, Bathurst, N. B., Aug. 2, 1943 (J. McDunnough).

The specimens were captured in the same locality as a series of *triplicis* and were at first taken for this species. The color of the fore wings is, however, decidedly deeper and there is less of the longitudinal striation which is at least partially present in *triplicis*. The genitalia, of course, at once separate the two species.

EXPERIMENTAL STARVATION OF FIRST-INSTAR LARVAE OF THE PALE WESTERN CUTWORM, *AGROTIS ORTHOGONIA* MORR.*

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The pale western cutworm, *Agrotis orthogonia* Morr, has been a serious pest in the semi-arid prairies of Western Canada since 1911. Only recently, however, has an effective control been developed which can be used in the spring of the year of outbreak. Seamans (1938), after many years of field observations, published a non-technical bulletin dealing with a method of control by starving the small cutworms early in the spring. The practice suggested consisted in cultivating the soil and keeping it free of all plant growth for a ten-day period after the cutworms had hatched and before the crop was seeded. It was stipulated that this cultivation be delayed until the newly hatched worms had fed to some extent on volunteer weeds and grain in the field. This control has given excellent results in the three years it has been tried in western Canada, but the reason for delaying starvation until the young worms had eaten was not definitely known.

One explanation advanced was that the newly hatched cutworms could withstand starvation if they had not already fed, but once having fed they were readily starved. This was based on the fact that the eggs hatch long before any food plants are available, and unfed first-instar larvae have been found in the field three and four weeks before green growth has appeared, but in no cases have larvae of various stages which have fed and begun to develop been able to survive a foodless period of four weeks. One series of eggs stored on ice in 1929 hatched, and the first-instar larvae survived at this temperature for over two months before they were fed. They then developed normally.

Definite experimental proof of this explanation was lacking, so an experi-

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ment was designed to compare the mortality of newly hatched unfed larvae with that of larvae that were fed for a short time and then starved.

The supply of eggs available was not sufficient to carry on a complete investigation under many different temperature, moisture and other environmental conditions. However, three hundred and fifty cutworms were hatched on the same day and were divided into seven series of fifty worms each, as follows:—

Series	Temperature	Moisture during starvation period	Food
1	Alternating *	—	Fed throughout (control series).
2	Alternating *	Added	Fed 5 days, starved 10 days, then fed again.
3	Alternating *	None	Starved 10 days, then fed
4	13° plus or minus 1°		Fed throughout (control series).
5	13° plus or minus 1°	Added	Fed 5 days, starved 10 days, then fed again.
6	13° plus or minus 1°	None	Starved 10 days, then fed.
7	13° plus or minus 1°	Added	Starved 10 days, then fed.

* 18 hours at 8° plus or minus 1° C., 6 hours at 21° plus or minus 0.5° C.

The two temperatures used are considered to be fairly representative of natural spring conditions in this section of the country.

The cutworms were reared individually from the time of hatching in clean, 1-ounce salve tins, 1¾ inches in diameter and 1 inch deep. They were fed on the leaves of young wheat plants grown in a greenhouse. Moisture was supplied on 1-inch squares of blotting paper except during the starvation periods of series 3 and 6, which were kept in empty, dry cans for the whole 10 days. All feeding larvae were given moisture in order to keep the food from becoming dry. The 7 series were fed and closely observed daily. The condition of many of the starving larvae was such that when a death was recorded it was thought prudent to retain the specimen until the next day, when it was rechecked. Two or three specimens were found to have been in a very weak condition but not dead when thus rechecked. The records were changed accordingly. It is often extremely difficult to determine whether an insect is dead or not unless considerable time can be devoted to each specimen. A slight amount of warming from a lamp bulb usually proved sufficient stimulus to cause some movement. The time that each series was exposed to room temperature while being fed was recorded daily and was seldom over half an hour at the beginning of the experiment, dropping to as little as five minutes later on when there were fewer larvae to feed.

The results of the experiment are contained in the accompanying table and charts. The effective mortalities of the various starved series are computed from the rule of Abbott (1925), in which: $M = 100 \frac{x - y}{x}$ where M is the percentage effective mortality of the treated series, x is the percentage survival of the control series and y is the percentage survival of the treated series.

In the accompanying table the effective mortalities of series 2 and 5 are computed from the figures of corresponding days after the start of the experi-

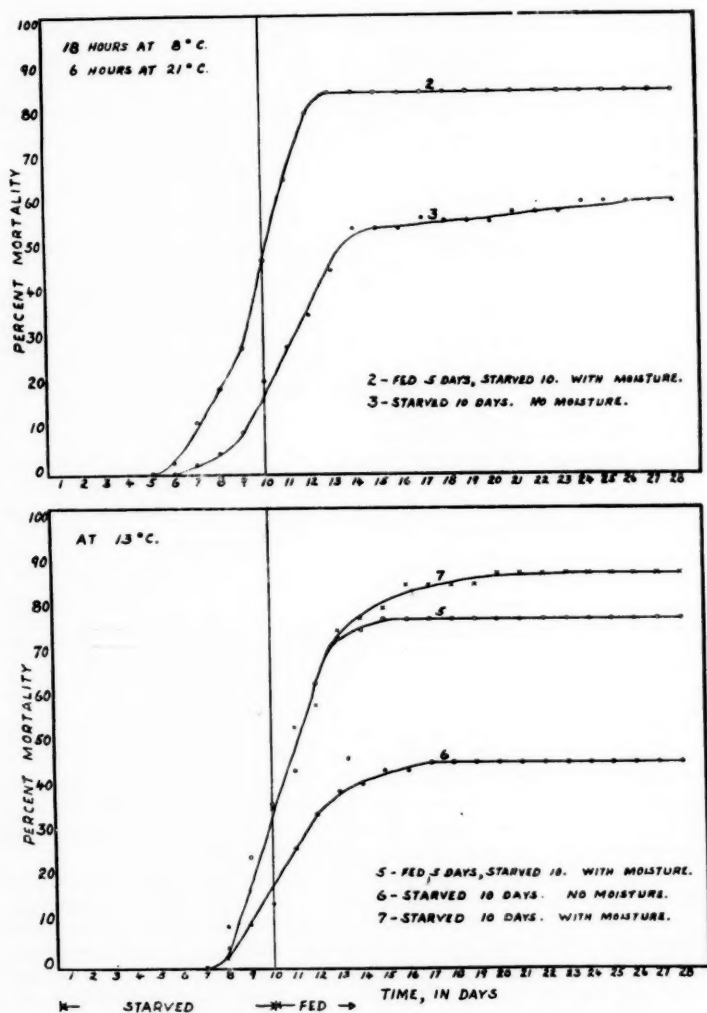


Fig. 1. Experimental starvation of the first-instar larvae of the pale western cutworm

ment, and not as arranged in the table. This is done because all the cutworms were of the same age, but series 2 and 5 were 5 days old before they were starved; their comparison with the control series, therefore, dates from the time of hatching.

The data are graphically presented in the accompanying figure, in which the two temperature groups are kept separate. Typical sigmoid mortality curves are the result in each series. The lethal factor, in this case starvation, was allowed to act over a period of only 10 days, producing mortalities ranging from 46 to 85 per cent. The levelling of each curve and its typical sigmoid shape is justification for the technique.

ANALYSIS OF RESULTS

It is apparent, first, that the effect of a 10-day starvation period extends beyond the actual period of starvation. It took 6 to 8 days for the lethal effect of starvation to act, and it lasted from 3 to 7 days after the end of the starvation period. An alternating temperature accelerates development of this species, and the effect is shown in the figure, where mortality begins and ends sooner than at the constant temperature of 13 degrees C. The mortality is higher, also, at the alternating temperature, when series 2 and 3 are compared with their corresponding series 5 and 6, respectively.

The more effective control obtained by allowing the cutworms in the field to feed for a short time before their food supply is destroyed is evident from a study of the figures. Although mortalities of 46 and 61 per cent were obtained by starving the newly hatched cutworms, a preliminary 5 days of feeding increased the mortalities to 78 and 85 per cent, respectively. Under conditions of cutworm outbreak a mortality of around 50 per cent is seldom of practical importance, but when 80 per cent are killed by one factor alone the crop is usually safe.

The reason for the increased mortality obtained by the preliminary feeding period is not contained in any of the data so far presented. Observations made and recorded during the progress of the experiment, however, give a very definite clue. When food was added after the end of the 10-day starvation period, notes were taken on whether or not each larva actually fed on the food supplied to it. In series 2 and 5 only 13 larvae, or 28 per cent, resumed feeding, whereas in series 3 and 6, 42 larvae, or 62 per cent, started feeding. These figures of course changed slightly, but not appreciably, during the next two or three days.

It was observed in a number of cases that larvae which were fed before starving became distended in the thorax and sometimes in the first one or two abdominal segments. The integument was stretched tight and the thoracic legs extended, while the whole front part of the body was filled with translucent, green, liquid matter. The fact that the abdomen remained for the most part relaxed and therefore of normal dark colouration suggests some digestive disturbance. The larvae would die in this distended condition, which somewhat resembles the pre-moult condition but which was confined to the fore part of the body.

It is therefore concluded that most larvae which are starved 10 days before feeding can start feeding without any apparent difficulty, and resume their development, while a much smaller percentage of larvae fed for 5 days before being starved can resume feeding.

So far the moisture factor has been ignored. That it complicates matters considerably may be seen from the behaviour of series 7. This series received exactly the same treatment as series 6, except that during the 10-day starvation period moisture was supplied on a 1-inch square of blotting paper. Their treatments after this period were identical. Up to the fourteenth day series 7 practically duplicated series 5, which was fed before being starved, but which also had moist blotter during the starvation period. Evidently moisture is detrimental to the young cutworm if it is to withstand starvation. By observation, the cutworms supplied with moisture had a far plumper appearance than those which were dry, but in this case appearance seems to mean nothing. In the field the activities of the first-instar cutworms are not so well known as those of the later stages, but from the observations available the larvae feed and move about mostly above ground. When their food is destroyed by thorough cultivation they still remain on or close to the soil surface. If they go below the surface of moist soil they will apparently meet unfavourable conditions that will kill 80 to 90 per cent whether or not they have already fed.

Table 1 - Effect of Starvation on the Survival of First-instar Pale Western Outworm Larvae

Treatment* Temperature	Series 1		Series 2		Series 3		Series 4		Series 5		Series 6		Series 7	
	c	f.s.f	f.s.f	Alt.	s.f	s.f	c	f.s.f	f.s.f	13°C.	s.f.d	s.f.d	s.f.w	s.f.w
No. days	% survival	% survival	% effective mortality	% survival	% survival	% effective mortality	% survival	% survival	% effective mortality	% survival	% survival	% survival	% effective mortality	% effective mortality
(1)	-	98	(2.0)	-	-	-	-	100	0.0	-	-	-	-	-
(2)	-	98	(2.0)	-	-	-	-	100	0.0	-	-	-	-	-
(3)	-	98	0.0	-	-	-	-	98	0.0	-	-	-	-	-
(4)	-	98	0.0	-	-	-	-	98	0.0	-	-	-	-	-
(5)	-	98	0.0	-	-	-	-	98	0.0	-	-	-	-	-
1	100	98	0.0	100	0.0	0.0	100	98	0.0	0.0	0.0	100	0.0	0.0
2	100	98	0.0	100	0.0	0.0	100	98	0.0	0.0	0.0	98	0.0	(2.0)
3	98	98	0.0	98	0.0	0.0	98	98	0.0	0.0	0.0	98	0.0	(2.1)
4	94	94	0.0	94	0.0	0.0	96	94	0.0	0.0	0.0	94	0.0	(2.1)
5	94	90	0.0	94	0.0	0.0	96	92	0.0	0.0	0.0	92	0.0	0.0
6	90	82	2.4	90	0.0	0.0	92	90	0.0	0.0	0.0	88	0.0	0.0
7	90	74	11.9	88	2.2	2.4	86	84	0.0	0.0	0.0	82	4.6	4.6
8	88	68	19.1	84	4.5	9.3	80	80	2.4	2.4	9.3	68	17.1	17.1
9	85	60	29.5	78	9.3	24.4	62	62	24.4	9.8	14.6	52	36.5	36.5
10	84	44	47.6	66	21.4	66	52	52	36.5	70	26.8	38	53.6	53.6
11	84	28	66.6	60	28.5	60	46	46	43.8	60	34.1	34	58.5	58.5
12	84	16	81.0	54	35.7	54	32	32	63.4	54	39.0	20	75.6	75.6
13	84	12	85.4	46	45.2	46	22	22	73.2	50	41.4	18	78.0	78.0
14	84	12	85.4	38	54.8	38	20	20	75.6	48	43.8	16	80.5	80.5
15	84	12	85.4	36	54.8	36	18	18	77.9	46	43.8	12	85.4	85.4
16	84	12	85.4	36	54.8	36	18	18	77.9	44	46.3	12	85.4	85.4
17	84	12	85.4	36	57.2	36	18	18	77.9	44	46.3	12	85.4	85.4
18	82	12	85.4	36	56.1	36	18	18	77.9	44	46.3	12	85.4	85.4
19	82	12	85.4	36	56.1	36	18	18	77.9	44	46.3	10	87.8	87.8
20	82	12	85.4	36	56.1	36	18	18	77.9	44	46.3	10	87.8	87.8
21	82	12	85.4	34	58.5	34	18	18	77.9	44	46.3	10	87.8	87.8
22	82	12	85.4	34	58.5	34	18	18	77.9	44	46.3	10	87.8	87.8
23	82	12	85.4	34	58.5	34	18	18	77.9	44	46.3	10	87.8	87.8
24	82	12	85.4	32	61.0	32	18	18	77.9	44	46.3	10	87.8	87.8
25	82	12	85.4	32	61.0	32	18	18	77.9	44	46.3	10	87.8	87.8
26	82	12	85.4	32	61.0	32	18	18	77.9	44	46.3	10	87.8	87.8
27	82	12	85.4	32	61.0	32	18	18	77.9	44	46.3	10	87.8	87.8
28	82	12	85.4	32	61.0	32	18	18	77.9	44	46.3	10	87.8	87.8
29	82	12	85.4	32	61.0	32	18	18	77.9	44	46.3	10	87.8	87.8
30	82	12	85.4	32	61.0	32	18	18	77.9	44	46.3	10	87.8	87.8

w - wet.

d - dry.

s - starved.

f - fed.

c - control.

SUMMARY

Experimental evidence is presented which shows that first-instar pale western cutworm larvae starved 10 days are less resistant when they have fed before being starved than when they have not fed. The experiments were carried on under two temperature conditions, one at 13° plus or minus 1° C. and the other at alternating temperatures of 8° plus or minus 1° C. for 18 hours and 21° plus or minus 0.5° C. for 6 hours.

At 13 degrees C. the first of the larvae which were starved from the time of hatching died on the eighth day, and by the seventeenth day the maximum mortality of 46.3 per cent was reached. The first of the larvae fed 5 days previous to being starved died on the eighth day also, but reached a maximum mortality of 77.9 per cent on the fifteenth day.

At alternating temperatures of 18 hours at 8 degrees C. and 6 hours at 21 degrees C., the first of the larvae starved from the time of hatching died on the seventh day and by the fourteenth day a mortality of 54.8 per cent, had been suffered, which was increased to 61.0 per cent by the twenty-fourth day. The first of the larvae which were fed 5 days previous to being starved died on the sixth day and a maximum mortality of 85.4 per cent was reached on the fourteenth day.

By observation it was determined that the increased mortality suffered by the two series that were fed 5 days before being starved was due to the fact that these larvae could not resume feeding. Larvae starved from the time of hatching could start feeding as soon as food was supplied them. The percentages of larvae feeding after starvation were 28 and 62 per cent, respectively. A digestive disturbance is suspected, since the larvae in the fed series bloated in the fore part of the body during the starvation period.

Moisture plays a prominent part during a period of starvation. A series starved dry at 13 degrees C. suffered a 46.3-per cent mortality, while a duplicate series supplied with moist blotting paper died to the extent of 87.8 per cent. The latter series almost exactly duplicated a series that was fed before starving.

LITERATURE CITED

Abbot, W. S. 1925. A Method of Computing the Effectiveness of An Insecticide. Jour. Econ. Ent. 18 (2): 265-267, April, 1925.

Seamans, H. L. 1938. The Pale Western Cutworm and Its Control. Canada Dept. Agr., Farmers' Bulletin No. 59, April, 1938.

BOOK NOTICE

A Bibliography of the Homoptera (Auchenorrhyncha), in Two Volumes, by Zeno Payne Metcalf, D. Sc. Obtainable from Department of Zoology, P. O. Box 5215, State College Station, Raleigh, N. C. Price \$7.50 plus .24 (postage).

Few of the major groups of insects in North America have attracted a larger number of systematic workers in the last quarter century than the Heteroptera and the Homoptera. There is little doubt that the publication of the excellent Van Duzee catalogue in 1917 was a prime incentive in attracting many students to these orders. Subsequently, students of the Homoptera have been favored with even more elaborate "world catalogues" of the Membracidae and Fulgoroidea, the latter the product of the pen of Dr. Metcalf. It will doubtlessly require many years to bring to completion the world catalogues of the Homoptera, and until such time the present bibliography will be especially useful to workers in groups in which no general catalogue is available.

Apart from its value to students of classification, who will use the bibliography as a companion work and supplement to the existing systematic indices, it will, because of the many annotations and the several special features embodied in Volume II, appeal to a much wider range of workers, including morphologists, physiologists, students of insect distribution, teachers of general entomology, and economic workers engaged in problems of insect bionomics and control.

The bibliography consists of three parts. Volume I (886 pp.) contains a list of approximately 8,000 titles, arranged in chronological order under the authors, the latter listed alphabetically. Under many titles there are brief but precise annotations, which, in most instances, should be sufficient to enable the reader to decide immediately whether it is necessary for his purposes to consult a particular reference or otherwise. Volume II (186 pp.) consists of two parts: a List of Periodicals and a Topical Index, the former containing the abbreviations used in Volume I, and the latter consisting of a general part which is devoted to morphology, physiology, economics and similar subjects, a taxonomic part which indexes the titles that refer to the super-families, families and sub-families, and a geographic part which classifies papers dealing with Homoptera from various parts of the world.

The bibliography records all titles which have come to the author's notice up to June 1, 1942. The title of each paper included, its place and date of publication, the volume number and the pages have been carefully checked against the original to ensure accuracy of citation. The bibliography aims to be as complete as possible but omits reference to books and papers on general zoology and general entomology which do not include specific reference to the Homoptera, or unless they mark definite turning points in fundamental concepts. Likewise omitted are works on parasitic insects and plant pathology unless they contain definite references to the Homoptera concerned. Other brief notes, summaries, reviews of previously published articles and press reports are omitted unless they contain new information. A careful perusal of the work leaves the reader with the impression that the author has been exceedingly thorough in his compilation of all the pertinent literature on the subject of Homoptera, and that he has indeed fulfilled his expressed desire "to be liberal, believing that it is much easier to ignore a citation that is included than it is to correct errors that are due to a citation that has been excluded."

The present work is clearly printed on a good quality of stock. It might have proved advantageous to have included the entire work in a single volume, if by the use of smaller type and other devices the bulk of the volume could have been kept within reasonable limits.

That a publication of the magnitude of this Bibliography has been produced during a period of wartime restrictions is quite remarkable. That it is the product of the pen of Dr. Metcalf is sufficient proof, to all those familiar with his previous writings, that it is executed in the same thorough and painstaking fashion as is characteristic of his former publications.

G. S. Walley.

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